Draft

Spallation Neutron Source Interface Control Document

1.5.6.1 Ring High Level RF System and 1.9.5 Ring Controls

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Approvals

1.5.6.1 High Level RF System   1.9.5 Ring Control System

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Spallation Neutron Source
Interface Control Document

Ring High Level RF System
and
Integrated Control System.

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CONTENTS

1. Scope

This document provides the interface requirements between the Ring high level RF (HLRF) system and the Integrated Control System (ICS).

This document is intended to be a guideline for the design of SNS Ring high level RF control system.

This document may be modified as a change request to the control system. Proposed changes require Ring HLRF System and ICS review and approval.

2. Overview

The Spallation Neutron Source (SNS) consists of a front-end system, a linear accelerator, an accumulator ring, and mercury target. The front-end system produces a beam of H^- ions and injects it at 2.5 MeV into a following linear accelerator for further acceleration to 1 GeV. The accumulator ring has circumference of 248 meters that is designed to accumulate $2x\ 10^{14}$, 1 GeV protons in 1 ms, via charge exchange injection of H^- beam. After the accumulation, the beam is extracted using a fast kicker magnet and sent to the mercury target. The purpose of the accumulator ring RF system is to maintain a 250ns gap for the 200ns rise time of the extraction kicker while maintaining low peak beam current and large momentum spread.

The design of SNS Ring RF system is a dual harmonic system running with h=1 and h=2 which imply RF frequencies of f1 = 1.05 MHz and f2 = 2.11 MHz. Three cavities will be used for h=1 system, with two gaps per cavity and 10kV per gap. There will be one power amplifier per cavity to compensate the heavy beam loading at h=1. The h=2 RF system will consist of one cavity with two gaps at 10kV per gap, driven by a single power amplifier.

An Allen-Bradley PLC-5 will be used for SNS Ring High Level RF controls. Two dedicated RIO ports on the PLC will be used for two RIO buses, each bus to control two cavity systems via RIO and Flex I/O interface. Several REDI Panels will be installed on each of the RIO buses. Another dedicated DH+ port on the PLC will be used for a local PC running RS View or PLC programming. See figure 1, a proposed architecture for SNS ring high-level RF system.

3. VME Interface Options

There are three options that could be used to interface between SNS global ICS and Ring high level RF system, Blue Hose interface, Ethernet interface and ControlLogix gateway.

3.1. Blue Hose Interface

The Allen-Bradley VMEbus remote I/O scanner modules (6008-SVnR) allow a VME master processor (IOC) direct access to I/O adapter devices on the Allen-Bradley Universal Remote I/O link. The VMEbus I/O scanner modules provide up to 230.4k bit/s communication and continuous block-transfers. 1771-DCM PLC direct communication module provides a remote I/O adapter port for a local PLC processor (Ring High Level RF PLC) to communicate with a remote I/O scanner port of a supervisory processor (IOC) across a remote I/O link. Figure 2 shows the Blue Hose interface between IOC and PLC-5.

3.2. Ethernet Interface

The Allen-Bradley 1785-ENET Ethernet Interface Module provides an Ethernet port for a 1771-platform PLC-5 processor, so that it can communicate with IOC via Ethernet link. Figure 3 shows this interface option.

3.3 ControlLogix gateway

A ControlLogix 5550 can be used as a gateway between DH+ Network and Ethernet. See figure 4.

4. Performance Requirement

There are about 500 bits per cavity system or total of 2k bits data will be transferred from PLC to VME IOC. As a minimum requirement, the update rate on operator screens shall be at least once every 5 seconds.

The detailed bits definition information along with their names, types and sources is described in Appendix A.

Figure 1. Ring High Level RF Control Architecture

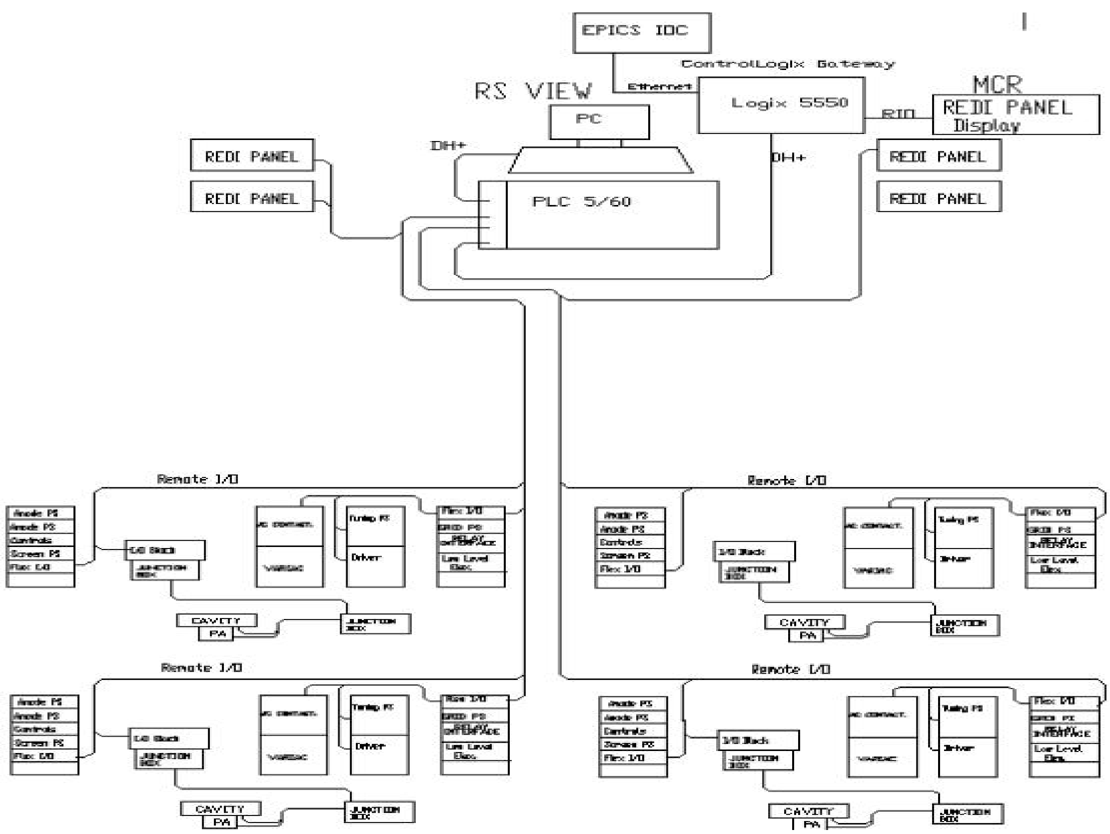


Figure 2. Blue Hose Interface Between IOC and RF PLC

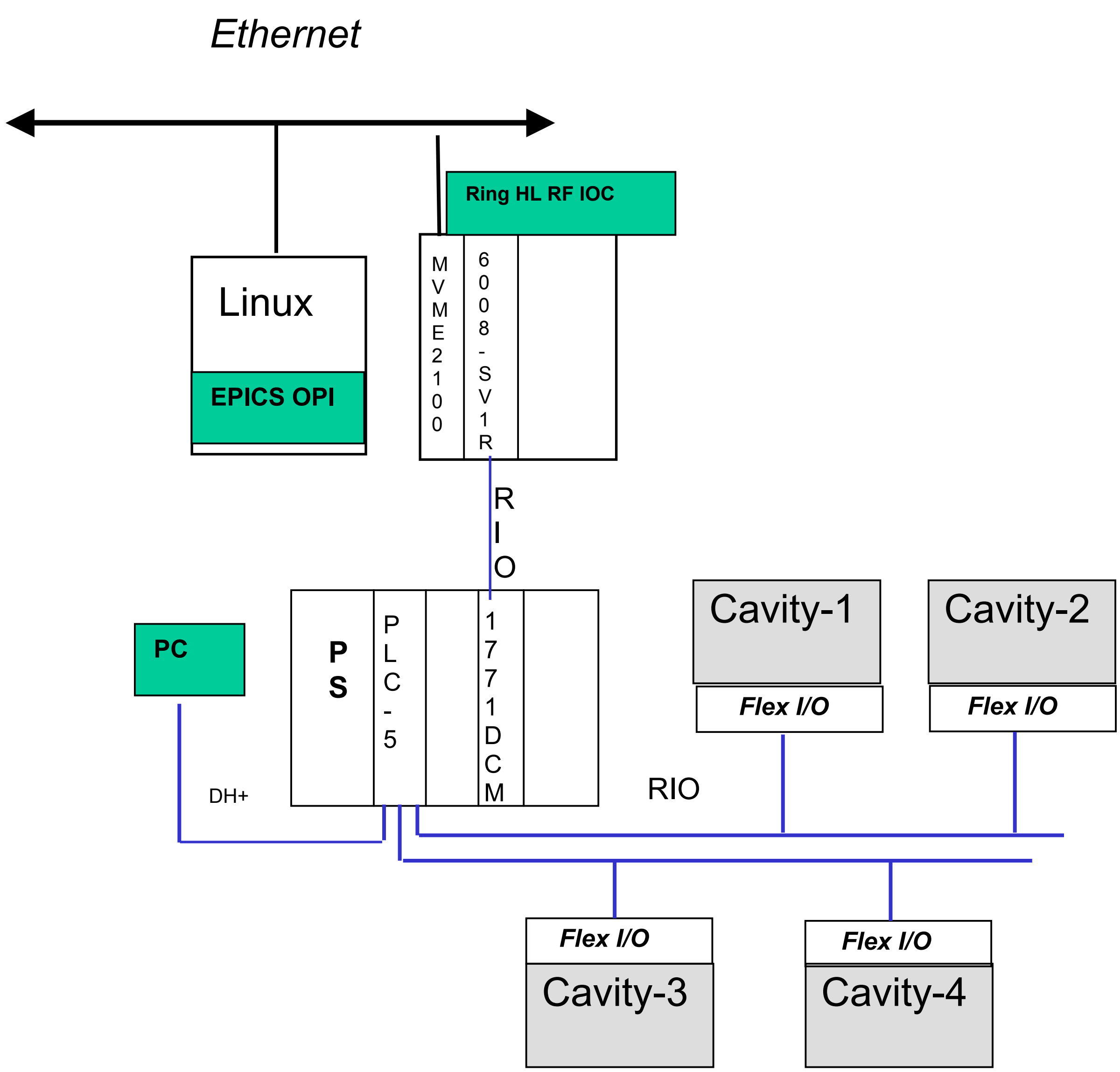


Figure 3. Ethernet Interface Between IOC and RF PLC

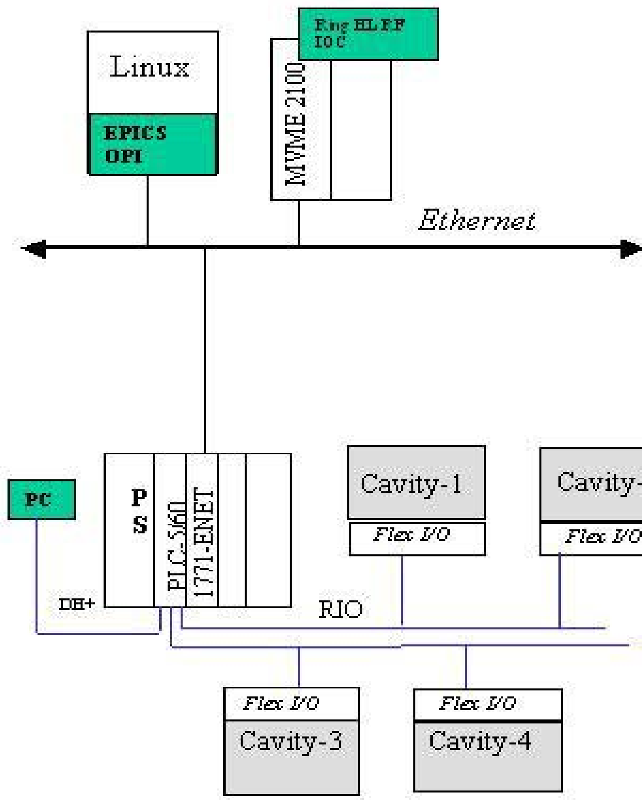
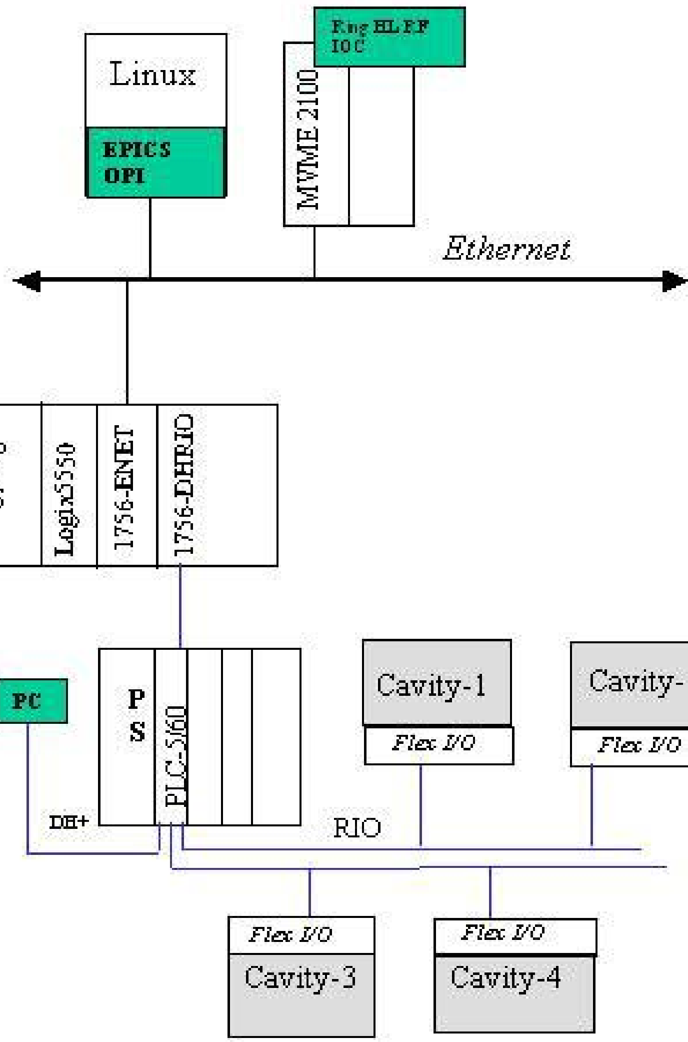


Figure 4. Logix 5550 Gateway Configuration



Appendix A. Bit Definitions

Type	***Source***	***Name***
	Anode First Input Module	
Sink Inp	303 #1	HV On Status
Sink Inp	303 #1	HV Inh Status
Sink Inp	303 #1	Loc/Rem Status
Sink Inp	303 #1	Over-Voltage Status
Sink Inp	303 #1	Interlock Status
Sink Inp	303 #1	Overload Status
Sink Inp	303 #1	Arc Status
Sink Inp	303 #1	Power Fault Status
Sink Inp	303 #1	Coolant Fault Status
Sink Inp		WATER LEAK
Sink Inp		WATER MAT FAULT
	Anode Second Input Module	
Sink Inp	303 #2	HV On Status
Sink Inp	303 #2	HV Inh Status
Sink Inp	303 #2	Loc/Rem Status
Sink Inp	303 #2	Over-Voltage Status
Sink Inp	303 #2	Interlock Status
Sink Inp	303 #2	Overload Status
Sink Inp	303 #2	Arc Status
Sink Inp	303 #2	Power Fault Status
Sink Inp	303 #2	Coolant Fault Status
	Anode Third Input Module	
Sink Inp	402	HV On Status
Sink Inp	402	HV Inh Status
Sink Inp	402	Loc/Rem Status
Sink Inp	402	Over-Voltage Status
Sink Inp	402	Interlock Status
Sink Inp	402	Overload Status

Sink Inp	Flow-1	303 #1 Water Flow
Sink Inp	Flow-2	303 #2 Water Flow
Sink Inp	Fan	Control Box TC Fault
Sink Inp	Door	Cabinet Access Door Inerlock
Sink Inp	Extnl	Remote Interlock Link
Sink Inp	PLC	PLC I/L Trip readback

Cap Bank Module

Sink Inp		Crowbar circuit interlock
Sink Inp		Crowbar fuse interlock
Sink Inp		Overcurrent
Sink Inp		Airflow fault
Sink Inp		Door interlock
Sink Inp		PS shorting bar
Sink Inp		Crowbar OT
Sink Inp		Load fault
Sink Inp		Cubical OT
Sink Inp		Heat Lamp interlock
Sink Inp		CR6 NO C1 Dump Res
Sink Inp		CR6 NC C1 Dump Res
Sink Inp		CR7 NO C2 Dump Res
Sink Inp		CR7 NO C2 Dump Res

PA / Cavity Interlocks & Statuses

Sink Inp	Local Switch
Sink Inp	Remote Switch
Sink Inp	Attenuator Water Flow
Sink Inp	Tube Water Flow
Sink Inp	Cavity Water Left Flow
Sink Inp	Tube Over-Temp
Sink Inp	Cavity Over-Temp Left
Sink Inp	Cavity Water Flow Right
Sink Inp	Cavity Over-Temp Right
Sink Inp	Cables
Sink Inp	Grid Under-Voltage
Sink Inp	Filament Under-Voltage
Sink Inp	Flushing Air Flow
Sink Inp	Tube Air Flow

Sink Inp	Screen Over-Load
Sink Inp	Ross Relay Readback
Sink Inp	Filament Contactor Readback

Variac Interlocks

Sink Inp	Blower Contactor Readback
Sink Inp	Blower Motor Over-Load
Sink Inp	Crash
Sink Inp	Filament Safety
Sink Inp	Blower Under-Voltage
Sink Inp	Variac Door Readback
Sink Inp	Variac Low Limit
Sink Inp	Variac High Limit
Sink Inp	Vacuum
Sink Inp	HV Safety
Sink Inp	Bldg Crash
Sink Inp	HV READY
Sink Inp	Ross Relay Control Relay

Tuning PS Interlocks

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Appendix B. Schedule

Dates	Activities
03/31/02	Preliminary Ring High Level ICD.
?	Final Ring High Level ICD
04/01/04 – 09/30/04	Ring High Level RF system commission
10/01/04 – 09/30/05	Ring RF system integration

References

1. Spallation Neutron source Design Manual June 1998
2. Allen-Bradley & Rockwell Software, Inc Product Catalogs